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RESERVE

**GUAM AGRICULTURAL EXPERIMENT STATION**  
**ISLAND OF GUAM**  
Under the supervision of the  
**UNITED STATES DEPARTMENT OF AGRICULTURE**

**REPORT OF THE**  
**GUAM AGRICULTURAL EXPERIMENT**  
**STATION**  
**1923**



Issued April, 1925



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## GUAM AGRICULTURAL EXPERIMENT STATION, ISLAND OF GUAM

[Under the supervision of the Office of Experiment Stations, United States Department  
of Agriculture.]

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Washington, D. C.

May, 1925

REPORT OF THE GUAM AGRICULTURAL  
EXPERIMENT STATION, 1923

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REPORT OF THE ANIMAL HUSBANDMAN IN CHARGE

By C. W. EDWARDS

The island was visited by a typhoon on March 27, 1923. Although the storm was not so severe as that of July, 1918, it did considerable damage to the island in general and to the station in particular. Buildings and growing crops in all sections were injured. The estimated damage to the station property was \$8,000, buildings, roads, and fences being harmed to a greater extent than would otherwise have been the case had funds been available for making much needed repairs of long standing. At the close of the year, through a transfer of funds, there was allotted to the station the sum of \$5,000 for making repairs of a temporary nature and for permanently restoring the office building (fig. 1). An equal amount is needed to complete the work properly.

Owing to a reduction in the appropriation, it has been impossible to fill the positions of agronomist-horticulturist and extension agent at the station, and it therefore devolved upon the animal husbandman to devote a large part of his time to supervising the work of the agronomy and horti-

cultural divisions. He was absent from the station for nearly four months of the year covered by this report for the purpose of studying agricultural conditions in the Philippines, conferring with island officials regarding experiment station matters generally, and securing certain propagating material.

Only a small amount of experimental work was done with the station livestock, because of the lack of funds for providing feed for the animals and employing the necessary labor. Efforts were confined principally to the continuation of experiments having for their object the production and development of improved breeding stock for local distribution.

SWINE

Hog cholera carried off fully 60 per cent of the swine of the island during the past year. As was the case some years ago, the disease appeared among pigs feeding on kitchen scraps from the Marine barracks. It is thought likely that the cholera or-



ganisms were conveyed through this means. By maintaining a strict quarantine at the station it was possible to keep the station herd free from the disease.

#### FEEDING TESTS

**Rice, fresh coconut, and meat scraps for weanlings.**—At 10 weeks of age, 18 grade Berkshire pigs were placed on native grass pasture, supplemented with a ration consisting of 2 parts by weight of cooked damaged rice, 1 part fresh coconut, and 10 per cent meat scrap. The pigs were kept in colony pens and fed during a period varying from 62 to 86 days. The entire lot

probably too large for pigs of the age of those tested.

**Breadfruit, copra meal, rice, cowpeas, and tankage for sows with litter.**—Four grade Berkshire sows were fed twice daily, during the period they were suckling their litters, all they would eat of a ration consisting by weight of 4 parts cooked breadfruit, 2 parts copra meal, 1 part rice, and 1 part cowpeas. In addition, they were given 2 ounces daily of tankage and free access to a mineral mixture made up by weight of 40 parts of charcoal and 20 parts each of wood ashes, local lime, and salt. Each sow with her litter was confined to a pen and given plenty of fresh Para grass. All sows kept in

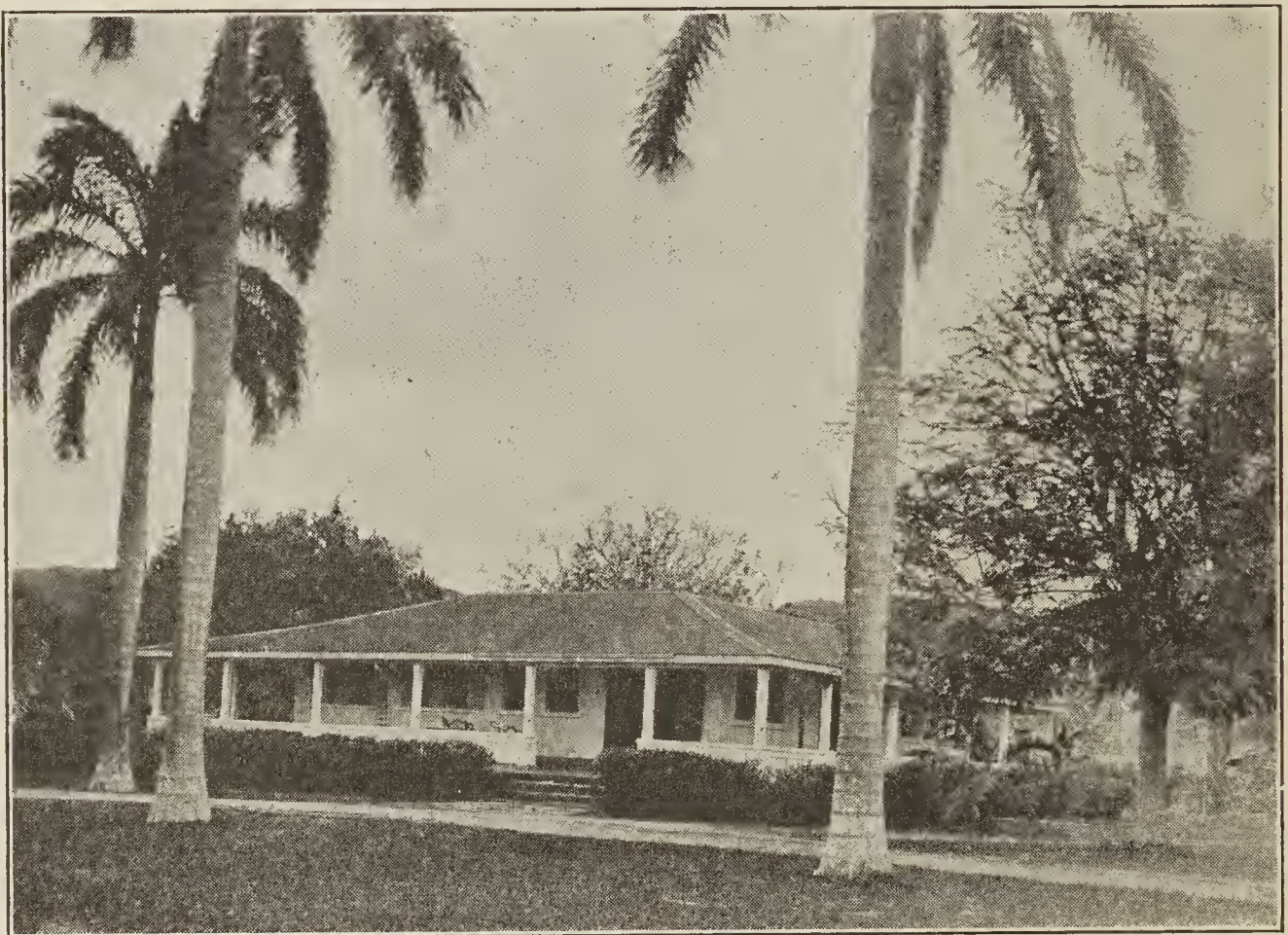


FIG. 1.—Office building reconstructed of reinforced concrete

made an average daily gain of 0.61 pound per head, and required on the average 417.96 pounds of feed per head to produce 100 pounds of gain. Notwithstanding the low rate of growth and the large quantity of feed consumed per unit of increase, owing to the cheapness of the combined ration, the gains were made at the comparatively low cost of 7.7 cents per pound. Both size and weight were noted to vary markedly throughout the test, which may partly account for the slow rate of gain. The feeding of a higher percentage of meat scrap would have been likely to result in a better gain than was made. The proportion of fresh coconut fed was

good condition, and the growth made by the litters showed that they had an ample supply of milk.

All the ingredients except the tankage were produced locally, thus making the ration an economical one. Corn doubtless could be used in the ration in places where rice is not available at a reasonably low price. The rice fed consisted of cleaned sweepings, which cost 1½ cents per pound; the breadfruit was had for the cost of the labor involved in gathering and cooking the fruit; and the copra meal cost 1 cent per pound.

**Fresh cassava, copra meal, and tankage for sows with pig.**—From fully a month before breeding to 10 days previous



to farrowing, 4 grade Berkshire sows were fed a ration consisting of 2 parts fresh cassava and 1 part copra meal, in addition to receiving 2 ounces of tankage daily. The sows were allowed to run on Para grass pasture until a few days before farrowing. Each animal kept in good condition and farrowed a strong, healthy litter (fig. 2).

**Native variety of cassava for swine.**—The native or bitter variety of cassava is said by some to be poisonous when fed fresh to livestock. To determine its effect on swine, cassava was fed alone for a few days and in combination

hens are being continued in the hope of establishing a breed combining the characters of the native type with the size and egg-laying qualities of the pure blood. The progeny of the first generation resemble the male parent in color. There is a wide range of variation in the red color, however, and even that which closely approaches the red of the cockerels is readily distinguishable from it. All but a few of the progeny have single combs, and either white or yellow shanks. First matings within the cross were made in 1922, and several hybrids of



FIG. 2.—Sow No. 258. Litter fifteen-sixteenths Berkshire, one-sixteenth native

during a period of 30 days to both young and old pigs. No ill effects followed.

#### POULTRY

The typhoon of March 27 killed some of the best-bred poultry stock of the station and badly damaged the poultry plant. The five laying houses constituting the breeding unit had been repaired before the close of the year; but the brooder and colony houses, and yards and runs could not be properly repaired because of the lack of funds.

Breeding work continues to show successful results and becomes more and more interesting as it progresses.

#### RHODE ISLAND REDS CROSSED WITH NATIVE HENS

Experiments in crossing Rhode Island Red cockerels with selected white

the second generation have white plumage like that of the native hens. Neither hybrids of the first or second generation equal the native parents in egg production. In many cases, however, there is a decided improvement both in size of fowl and egg and in texture of egg shell.

#### SINGLE-COMB RHODE ISLAND REDS

Single-Comb Rhode Island Reds were imported from the States in 1919 for the double purpose of establishing a foundation stock for the station and of producing purebred fowls for distribution to the poultry raisers of the island. Later, it was decided to maintain an improved strain of purebred Rhode Island Reds in addition to the foundation stock. Some of the hens proved to be of low egg-producing capacity. Individual hens are steadily improving in this respect, however.



## CANTONESE

Five cockerels and six pullets of Cantonese or Chow chickens were secured from the Philippine Bureau of Agriculture during the year. The Cantonese is not a standard breed but a type of fowl which is raised in certain parts of China (figs. 3 and 4). The birds are very hardy, plump, and good producers of eggs, which, like the

hens, are small. It is thought that the Cantonese offer unusual possibilities for Guam, and work is being directed toward the establishment of improved strains of this type.

## PUBLIC STOCK IMPROVEMENT WORK

In addition to distributing 71 settings of eggs for hatching, the station disposed of 21 Rhode Island Reds, 1 native, and 74 grade chickens.



FIG. 3.—Cantonese cockerel



FIG. 4.—Cantonese pullet

## REPORT OF THE ASSISTANT IN AGRONOMY AND HORTICULTURE

By JOAQUIN GUERRERO

The typhoon of March 27 damaged most of the fruit trees of the island, especially avocado and mango trees, which were either in flower at the time or coming into bearing.

Plant diseases were less prevalent and troublesome than usual, and climatic conditions on the whole were favorable to crop production.

In continuation of the work dealing with the improvement of tropical fruits and vegetables, the station introduced a comparatively large amount of propagating material, chiefly from the Philippines.

## FORAGE CROPS

The station again made large distributions of propagating material of improved forage grasses to aid in developing the livestock industry of the island. These distributions will not only help to supply forage of high feeding value, but they will also serve to show the adaptability of the various grasses to the different local soils. Napier grass (*Pennisetum purpureum*) seems well adapted to

both lowland and the upland cascajo soils.

## GRASSES

Both plat and field tests, begun November, 1920, and October, 1921, respectively, are being continued with Napier grass, Guatemala grass, and Japanese cane to determine their relative value as soiling crops. Napier grass and Guatemala grass have been found to keep down weed and other growth to better advantage than is true of Japanese cane. Other forage crops tested during the year include Para, *Paspalum*, *Pennisetum setosum*, Jaragua, molasses, Guinea, Napier, Rhodes, and Wonder Forage grasses.

**Para grass** (*Panicum barbinode*).—In continuation of work dealing with the various methods of planting Para grass, the stems were scattered over a field from which corn had recently been removed, after which they were well disked into the soil. Broadcasting was done in October, and cuttings yielding at the rate of 9.64 tons per



acre were secured eight months later. The cost of planting per acre under this method was \$4.60, which is less than in case of cuttings planted in hills or dibbled. Broadcasting or strewing cuttings on newly cleared or plowed land during the rainy season is the cheapest of all methods of planting Para. At the Cotot stock farm, however, it was found that the stand resulting from this method of planting was more easily killed by pasturing than was true of the same kind of crop grown by other methods allowing for the establishment of a deeper root system.

**Jaragua grass** (*Cymbopogon rufus*).—Planted in a small trial plat August

**Molasses grass** (*Melinis minutiflora*).—Seed of molasses grass, obtained from the United States Department of Agriculture, was planted at the station August 27, 1922. A good stand resulted, the plants completely covering the ground within a short time (fig. 6). A few of the plants bore flowers by December 17, but failed to seed. An estimated yield of 10.2 tons per acre was harvested from the plat April 5, 1923. Molasses grass has a characteristic odor, and probably for this reason the animals at the station refuse to eat it. The grass makes a very thick, heavy growth, and both surfaces of the leaf bear a heavy, soft or velvety pubescence.



FIG. 5.—Jaragua grass (*Cymbopogon rufus*), 145 days after cutting

27, 1922, Jaragua grass started to bloom November 26 at the height of about 3 feet. The stand was poor and the plants were therefore allowed to go to seed. The first cutting, April 5, 1923, yielded at the rate of 5.1 tons of green forage per acre. Jaragua grass is a perennial grass having long, slender, leafy stems bearing numerous small seeds which are provided with long, tender, brownish awns (fig. 5). The plant stools readily and the tuft often reaches a foot in diameter. Numerous small leaves grow from the bottom of the culms, probably indicating that the plant will withstand light pasturing only. As a soiling crop Jaragua grass is inferior to most of the coarse forages of Guam.

**Wonder Forage crop.**—Seed of this grass was obtained from the Hawaii Experiment Station and planted in a test plat January 13, 1923. The plants were in blossom March 31, and a few heads were beginning to mature May 14, 1923. No yield was secured as the planting gave a poor stand. The stand was allowed to go to seed.

**SORGHUM** (*Holcus sorghum* [*Andropogon sorghum*])

The variety test with 26 varieties of saccharine and nonsaccharine sorghums, begun in January, 1922, was completed during the year, and a total of five crops, one of which was re-



TABLE 1.—Yield per acre in five cuttings of sorghum varieties, planted January 28, 1922

Variety	First cutting		Second cutting		Third cutting		Fourth cutting		Fifth cutting		Total	
	Grain	Forage	Grain	Forage	Grain	Forage	Grain	Forage	Grain	Forage	Grain	Forage
Shallu.....	Pounds 3,225.0	Tons 4.0	Pounds 1,725.0	Tons 7.5	Pounds 475.0	Tons 3.0	Pounds 600.0	Tons 3.20	Pounds 2,012.5	Tons 3.7	Pounds 8,037.5	Tons 21.40
Sourless cane.....	3,600.0	12.5	1,937.5	17.5	825.0	9.5	1,825.0	9.00	1,000.0	10.0	9,187.5	58.50
African cane.....	5,000.0	13.5	2,000.0	22.5	1,500.0	9.5	2,600.0	10.90	3,287.5	13.3	14,387.5	69.70
Bishop's kafir.....	1,525.0	3.5	2,037.5	13.0	1,625.5	3.5	437.5	1.40	150.0	1.5	4,312.5	22.90
White milo.....	2,300.0	4.5	1,025.0	12.0	287.5	3.0	237.5	2.50	250.0	1.5	4,100.0	23.50
Darso.....	2,450.0	5.0	1,200.0	8.0	537.5	5.0	1,000.0	5.30	300.0	6.3	5,487.5	29.60
Brachet kaoliang.....	2,550.0	6.3	1,050.0	11.5	462.5	5.8	962.5	10.30	937.5	5.5	5,962.5	39.40
Spur feterita.....	2,300.0	10.0	1,050.0	8.0	575.0	5.0	737.5	7.40	400.0	4.0	5,062.5	34.40
Standard feterita.....	1,537.5	6.0	1,112.5	7.8	525.0	3.5	625.0	6.20	375.0	4.0	4,175.0	27.50
Schrock kafir.....	3,037.5	5.0	1,487.5	8.5	537.5	4.2	537.5	1.95	387.5	3.5	5,987.5	23.15
Dwarf begari.....	825.0	4.0	800.0	7.5	100.0	3.0	250.0	2.10	225.0	4.5	2,200.0	21.10
Blackhull kafir.....	2,962.5	3.9	737.5	4.5	237.5	3.0	225.0	2.40	375.0	2.8	4,537.5	16.60
Dwarf kafir.....	1,762.5	4.0	800.0	7.5	312.5	3.7	437.5	1.50	100.0	1.8	3,412.5	18.50
Early kafir.....	1,475.0	4.5	800.0	7.8	525.0	5.0	687.5	2.70	362.5	3.5	3,850.0	23.50
Dawn kafir.....	1,950.0	6.3	1,075.0	8.5	375.0	5.5	362.5	3.10	175.0	2.6	3,937.5	26.00
Kafir sorgo.....	2,062.5	7.0	1,050.0	13.8	525.0	6.8	500.0	6.00	125.0	7.0	4,262.5	40.60
Honey cane.....	450.0	11.5	(1)	-----	-----	-----	-----	-----	-----	-----	450.0	11.50
McClean's sorgo.....	2,025.0	8.3	712.5	8.5	525.0	6.8	1,287.5	6.50	912.5	6.3	5,462.5	36.40
Clubhead sorgo.....	1,812.5	9.6	725.0	13.5	625.0	5.3	1,175.0	4.00	450.0	1.0	4,787.5	33.40
Sumac.....	2,350.0	7.0	637.5	16.5	1,465.0	8.5	1,935.0	7.00	687.5	7.0	7,075.0	46.00
Seeded Ribbon cane.....	1,175.0	4.7	400.0	13.5	50.0	2.3	(1)	-----	-----	-----	1,625.0	20.50
Orange cane.....	662.5	3.2	350.0	17.0	487.5	3.5	935.0	3.00	320.0	3.0	2,755.0	29.70
Dwarf Ashburn.....	1,850.0	7.5	837.5	12.0	462.5	6.0	1,575.0	6.00	450.0	5.0	5,175.0	36.50
Red Amber cane.....	3,412.5	8.5	875.0	10.0	375.0	3.5	1,087.5	3.00	275.0	3.0	6,025.0	28.00
Black Amber cane.....	1,912.5	5.7	600.0	6.5	362.5	3.2	987.5	3.00	612.5	2.5	4,475.0	20.90
Yellow milo.....	1,112.5	3.5	850.0	9.0	325.0	2.6	1,050.0	3.00	362.5	4.1	3,700.0	22.20

<sup>1</sup> Dead.



ported upon last year, has been secured. The only crop maturing during the rainy season produced grain of low yield and poor quality. All the experiments to date show that crops maturing in the rainy season produce a high forage and a low grain yield compared with crops maturing in the dry season or period of light rains. It is not considered wise to attempt to secure more than five crops from a single planting. Table 1 gives the yield per acre of the five crops produced at the station.

the cost of growing the various legumes and the length of time each crop efficiently covers the ground. **Small bean test.**—Three plantings of small beans were made to determine their value as cover crops. Of the different varieties tested, black mungo gave the highest grain yield but was the latest to mature. The adzuki beans made the poorest cover crop, but were the first to ripen. The red and black rice beans tested are varieties which were found growing in the buff rice bean plat. In habit of



FIG. 6.—Molasses grass (*Molinis minutiflora*), showing dense growth

LEGUMES

**Cover crops.**—Cover-crop investigations were conducted on a more extensive scale than formerly. In this work a comparison is being made of

growth they closely resemble the buff variety. Table 2 summarizes the results of observations on period of growth and comparative tests of dates of planting.

TABLE 2.—Results of small bean variety test

Variety	Average length of time from planting to		Yield of seed per acre		
	Flowering	Ripening	Planted June 8, 1922	Planted Dec. 16, 1922	Planted Mar. 23, 1923
	Days	Days	Pounds	Pounds	Pounds
Rice bean (red).....	38.0	71.0	600.0	950.0	462.5
Rice bean (black).....	41.3	71.0	450.0	1,287.5	337.5
Rice bean (buff).....	39.7	72.5	487.5	1,212.5	625.0
Guam.....	39.0	66.5	500.0	1,112.5	837.5
Urd.....	44.3	75.0	250.0	612.5	675.0
Adzuki (red).....	33.7	63.5	500.0	1,100.0	550.0
Black mungo.....	44.3	75.0	400.0	1,300.0	1,125.0
Adzuki (buff).....	33.7	63.5	275.0	725.0	687.5



It will be noted that in general the highest yields resulted from the plantings of December 16, which is about the beginning of the usual dry season in Guam.

**Alfalfa** (*Medicago* sp.).—In the hope of securing a variety of alfalfa that can be successfully grown locally, the station imported seed of 3 varieties from India, 6 from South Africa, 4 from Hawaii, and 1 from the Philippines, where climatic conditions are somewhat similar to those obtaining in Guam. A portion of the seed of the Indian varieties was planted on an upland cascajo soil, and the remainder along with the other varieties on a low, well-drained, clay loam. Of the Indian varieties which were planted on the upland soil, Nadia No. 29, and a variety numbered 28, respectively, were the first to bloom. Each variety was clipped, and acid phosphate was then applied to the plat at the rate of 1,000 pounds per acre. The second cutting gave an ap-

preciable increase in yield of green forage over the first cutting, but the plants soon afterwards died from some unknown cause.

The lowland planting included 14 varieties, which were sown in drills or rows 1 foot apart. Preparatory to planting, the seed beds were put in excellent condition and the soil was inoculated. All varieties except the common alfalfa and a selected Chinese sort made a good stand. The plants were clipped at the time they were beginning to seed, and the plat was given an application of acid phosphate. A second cutting was necessitated about a month later by the typhoon which severely whipped the plants. Only a small amount of seed was obtained from these varieties, and little of it was viable. A root disease made its appearance in all the plats about the time the seed was ripening and carried off all but a few plants of each variety.

Table 3 summarizes the results secured from the tests.

TABLE 3.—Results of alfalfa variety tests

[Planted on upland soil August 16, 1922. Clipped January 11 and April 3, 1923]

Variety	Date bloomed	Average height	Yield of forage per acre		Total yield of forage per acre
			First clipping	Second clipping	
	1922	Inches	Pounds	Pounds	Pounds
Surat No. 27.....	Oct. 25	13.5	1,540.0	1,056	2,596.0
No. 28.....	Oct. 17	16.0	1,625.0	1,350	2,975.0
Nadia No. 29.....	Oct. 14	20.0	1,345.5	1,248	2,593.5

[Planted on lowland soil October 9, 1922. Clipped March 5 and April 4, 1923]

Surat No. 27.....	Nov. 29	37.0	1,425.0	4,000	5,425.0
No. 28.....	Nov. 21	38.0	2,025.0	4,400	6,425.0
Nadia No. 29.....	Nov. 18	35.6	1,950.0	3,750	5,700.0
Arabian.....	Dec. 16	25.2	950.0	4,700	5,650.0
Algeria.....	do.....	33.2	1,125.0	2,500	3,625.0
Chinese.....	do.....	27.8	670.0	2,950	3,620.0
Grimm.....	Dec. 18	29.6	2,300.0	1,650	3,950.0
Hunter River.....	Dec. 17	30.8	2,450.0	6,800	9,250.0
Provence.....	Dec. 18	37.6	3,350.0	3,550	6,900.0
Chinese (selected).....	Dec. 16	37.4	-----	800	800.0
Common.....	Dec. 18	26.6	-----	950	950.0
Molokai.....	do.....	33.4	850.0	2,225	3,075.0
Hairy Peruvian.....	do.....	32.8	3,600.0	3,325	6,925.0
Australian Broadleaf.....	do.....	37.0	4,800.0	4,075	8,875.0

ROOT CROPS

**Sweet potatoes** (*Ipomœa batatas*).—Eight varieties of sweet potatoes were received from the United States Department of Agriculture during the year. These were planted in the nursery for the propagation of stock for distribution. Later, cuttings from

the imported varieties and from seven local varieties were planted in a variety and fertilizer test. All plants had made a good start at the end of the year.

**Yam.**—Two varieties of yam (*Dioscorea latifolia* and *D. alata*), introduced from the United States Depart-



ment of Agriculture, were harvested during the year and furnished an abundance of seed material for further planting. A small quantity of seed of both varieties was distributed among interested farmers. *D. latifolia*, commonly called turkey-liver yam, bears an abundance of aerial tubers, which constitute its main crop. *D. alata*, on the other hand, bears only a few aerial tubers, and these are used principally for seed purposes. The main crop of this variety, as is true of most varieties of yams, consists of fleshy, underground tubers. Culinary tests have not as yet been made with either variety.

#### RICE (*Oryza sativa*)

Fertilizer experiments with rice have been in progress for seven years and have included comparative tests of ni-

was the more beneficial, the plat receiving nitrate producing approximately 65 per cent more clean paddy than did that receiving ammonium sulphate. When, however, these nitrogenous fertilizers were applied in combination with the other fertilizing materials, ammonium sulphate produced a much higher yield than did sodium nitrate. In the tests of fertilizers applied singly, acid phosphate gave the best results, followed by sodium nitrate. Acid phosphate in combination with potassium sulphate gave the poorest results, and lime, applied either singly or in combination with the fertilizers, failed to give as satisfactory results as did the plat receiving no treatment.

Most of the present cultivated rice fields of the island have been continuously cropped for many years, and, as



FIG. 7.—Planting rice on station plats

trate of soda (266 pounds per acre), sulphate of ammonia (200 pounds), acid phosphate (166.5 pounds), sulphate of potash (95 pounds), and lime (1,000 pounds), applied singly and in various combinations. The results of the tests show that acid phosphate in combination with ammonium sulphate produced the highest yield of clean, unhulled paddy, the average yield from this treatment being 61 per cent above that of the check plats. The next highest yield was obtained from the plats receiving these same compounds, but in addition, for two seasons, an application of potassium sulphate. Comparative tests of sodium nitrate and ammonium sulphate, applied singly, showed that the former

was indicated by these tests, could be greatly benefited by applications of certain commercial fertilizers.

During some years of the above-mentioned tests, yields at the station were below normal, probably owing to the isolation of the station plats, which are located some distance from other rice lands and are bordered by waste areas of heavy undergrowth (fig. 7). The rice bug's activities under these conditions were concentrated on the small areas. Apparently rice fields which are surrounded by cultivated or fallow fields are not so subject to attacks as are those near brush and grass. Attempts to grow rice out of season are failures, probably for the same reason.



**ADLAY** (*Coix lachryma-jobi*)

Variety and adaptation tests are being conducted with different varieties of adlay which were imported from the Philippine Bureau of Agriculture. The first planting, made December 14, 1922, on a one-fifth acre plat, was nearing maturity at the close of the year. It was observed in this test that many of the heads failed to fill, although they attained normal size.

Nine varieties, received in the second shipment, were planted in regular test plats March 3, 1923. All varieties had started to head by the close of the year.

**TREATMENT OF NEWLY BROKEN GRASSLAND**

Experiments were continued to determine the most practical methods of treating newly broken native grasslands which fail to produce satisfactory yields of certain crops. In a test begun in December to determine the relative efficiency of barnyard manure, lime, sulphur, and green manure on newly broken grass plats, barnyard manure gave the best results in the one crop thus far secured. The test is being continued.

**ROTATION V. CONTINUOUS CULTURE**

Corn, rotated with cowpeas and with velvet beans, has been compared with corn grown continuously since 1920. Five crops have been secured to date. In general, rotation has given some increase in yield over continuous culture, although the increase is not so marked as might be expected. Insect pests and rodents have greatly interfered with the success of the experiment.

**FRUIT INVESTIGATIONS**

Limb girdling or ringing, which is sometimes advocated as a means of bringing unprolific trees into bearing, was practiced on a number of trees and in most cases was successful. Many citrus branches died after bearing, however, and showed a marked, unnatural variation in amount of foliage and shape and quality of fruit produced. The treatment is not recommended for use in this climate where any injury to trees is likely to prove favorable for the development of fungus and other diseases.

**Orchard.**—The area of the orchard was extended by the planting of a number of introduced trees. Cover crops were grown to good advantage in the orchard and again proved their efficiency in keeping down weed and other volunteer growth.

**Nursery.**—Native orange and grapefruit trees are probably the descendants of seedling stock. Some of the varieties are very good and are considered superior to any of the sorts so far introduced. In an effort to meet the ever-increasing demand for citrus stock, the station set out several hundred seedlings to be budded, when of sufficient age, to the best native varieties for the production of propagating material for distribution.

**Mangoes.**—Both the Carabao and the Spanish varieties of mango grow on the island. Many of the Carabao trees are either barren or such shy bearers that their production of good mangoes is comparatively low. The Saipan trees are prolific and come into bearing from 4 to 6 years after planting. The fruit produced is of inferior quality, however. The Carabao tree requires from 15 to 30 years to come into bearing. In the Philippines it is claimed that the grafting of young seedling stock with cions secured from prolific fruiting branches of the Carabao result in the production of Carabao trees which come into bearing within 4 or 5 years. The Saipan, which is early maturing and very hardy, would probably furnish desirable stocks for such work. To test the feasibility of the method and with the hope of producing good mangoes locally, the station distributed several hundred Saipan seedlings for grafting at the proper time on Carabao trees.

**Citrus.**—Bark rot and die-back are very prevalent diseases among the citrus trees of the island. The former appeared in the station orchard during the year and two trees were lost in consequence. The orchard is being carefully watched and treated to guard against the spread of the disease.

A lime tree (*Citrus* sp. No. 1336, S. P. I. No. 37084), planted August 24, 1915, bore for the first time during the year, yielding between October 30 and December 28, 1922, 60 pounds of fruit. The flesh was juicy, extremely sour, of rather coarse texture and golden color. The tree died from the effects of bark disease a month after the last picking. A number of seedlings from this tree are being grown in the nursery.

Two varieties of orange, Valencia, No. 1458 (fig. 8), and Washington Navel, No. 1457, planted September 3, 1915, came into bearing about the latter part of the year. The fruit of the Valencia was oblong in shape and tapered slightly toward the base. The skin was smooth and thin, and turned



a pale orange color when the fruit was left on the tree until fully mature. The flesh was golden in color, juicy, subacid in flavor, and contained few seeds. Judging from the specimens produced in Guam, the Washington Navel orange of the Tropics differs in many respects from that produced in some other regions. The eating quality of the oranges was much inferior to that of most of the native varieties. In shape, the Washington Navel orange approached the spherical, and the skin was rough, about one-fourth inch thick, and failed to color properly. The flesh was white, coarse in texture, sweet in flavor, medium in juice, had large, firm vesicles, and was seedless. The Washington Navel orange is characterized by the presence of a sec-

#### GARDEN-VEGETABLE DEMONSTRATIONS

As was the case last year, only a small area was devoted to garden work.

**Lettuce.**—Selection work with lettuce, conducted in the hope of obtaining a head-producing strain, was seriously interrupted by the failure of the plants to seed during the rainy season and the general rapid deterioration of the seed. Mignonette has given more satisfactory results than any other variety so far grown at the station.

**Tomatoes.**—Selection work is being continued with the Cristobal variety of tomato. A very gradual improvement is being noted both in size and smoothness of fruit. Work was begun in the development of a new variety by crossing the Cristobal with introduced sorts.



FIG. 8.—Valencia oranges as grown at station

ondary imperfectly developed fruit inside, directly under the umbilicus. In the specimens produced the secondary orange varied in size from one-half to three-fourths inch in diameter, and the umbilicus from one-eighth to one-fourth inch in diameter. Both varieties were still producing at the end of the year.

**Roselle.**—During the year two varieties of roselle, Archer (white) and Rico (red), were received from the Philippine Bureau of Agriculture. Both were planted December 16, 1922, in a one-sixth acre plat in one section of the orchard, and are making fine growth.

**Pineapples.**—Two crops have thus far been secured from the pineapple fertility test, begun September 8, 1921. Sodium nitrate produced the highest yield per acre for both the Cayenne and Thorny Red varieties in the first crop, but ammonium sulphate gave the best results in the second crop.

#### SEED AND PLANT DISTRIBUTION

The distribution of seed and plant material continues to be of especial value in bringing about an improvement in the agriculture of the island and serves as an index of the adaptability of the different kinds of plants to the various districts.

In April, 1922, the station, working in cooperation with the Marine Corps, undertook the work of beautifying the grounds at the Sumay Post, an area embracing approximately 10 acres. The work is carried on under the direction of the station, and cuttings for hedges and ornamentals are being grown at the station by labor furnished by the Marine Corps. Hibiscus, camachile, and barleria are being utilized for hedges; hibiscus, bougainvillæ, allamanda, and palms for single shrubs; various small plants for border purposes; and Bermuda grass for sodding the lawns.



The general distribution of seeds and plants for the year included 3,531 packets of vegetable seed, 1,551 improved pineapple suckers, 863 tomato seedlings, 2,131 pepper plants, 468 eggplants, 382 papaya plants, 82 avocado plants, 790 other economic plants, 19,800 rooted ornamental cut-

tings, 157 taro suckers, 13 pounds of leguminous seed, 40 pounds of sorghum, 280 seedlings and 14 packets of tobacco seed, 31 sacks of miscellaneous grasses, 27 packets of white and red roselle seeds, a few alfalfa seeds, rice, and some imported sweet potato cuttings.

REPORT OF THE EXTENSION DIVISION

By C. W. EDWARDS

As was the case last year, the governor generously extended sufficient financial aid from Island Government funds to enable the extension work to be continued on a small scale. Seeds and plants for distribution were also paid for from the island treasury.

A reduction in the station's personnel made it impossible to conduct work efficiently throughout the island and activities were therefore confined to the districts of Asan, Piti, Sumay, and Agat. The projects of the previous year were continued with the exception of the school-garden demonstrations, which were conducted entirely by the school department.

BOYS' AND GIRLS' CLUB WORK

The assistant in extension assumed the duties of club supervisor in each

district, and completed two seasons' work. The club activities supervised included corn, bean, garden, root crops, copra, pig, and poultry clubs. Mimeographed instructions were again distributed to each club member. A total of 451 boys and girls enrolled during the two seasons, and of this number 419 completed the work and submitted reports.

ADULT DEMONSTRATION WORK

Farmers were again assisted to secure and properly use improved seeds, plants, farming implements, and breeding stock. The station made every effort to induce the farmers to provide improved facilities for drying copra and to employ better farming methods generally.

METEOROLOGICAL OBSERVATIONS, 1922-23

TABLE 4.—Condensed meteorological data for the fiscal year 1923

Month	Temperature					Barometer monthly mean	Total precipitation	Prevailing direction of the wind
	Maximum	Minimum	Mean maximum	Mean minimum	Monthly mean			
1922	° F.	° F.	° F.	° F.	° F.	Inches	Inches	
July	90.0	75.0	87.28	76.62	81.95	29.746	15.33	Southeast.
Aug	91.0	74.0	86.98	76.53	81.75	29.716	14.60	Northeast.
Sept	90.5	74.0	86.33	75.73	81.03	29.718	19.49	Do.
Oct	91.0	75.0	88.46	77.06	82.76	29.737	4.76	East.
Nov	91.5	74.5	87.84	77.07	82.46	29.747	7.10	Do.
Dec	91.0	73.5	87.54	76.20	81.87	29.738	3.29	Northeast.
1923								
Jan	89.0	74.0	86.79	76.19	81.49	29.742	3.82	East.
Feb	89.0	73.5	87.04	75.38	81.21	29.749	6.93	Do.
Mar	90.5	74.5	86.88	76.43	81.66	29.700	15.05	Northeast.
Apr	91.5	74.0	88.75	77.13	82.94	29.724	3.45	Do.
May	91.0	73.0	88.08	77.38	82.73	29.717	3.79	East.
June	91.0	74.5	87.94	77.68	82.81	29.752	6.93	Do.
Total							104.54	

The outstanding meteorological event of the year was the typhoon of March 27, 1923, which, as already noted, did

considerable damage to buildings, livestock, and growing crops in all parts of the island and especially at the station.





